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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Attorney Docket No. LAMA114394

TRANSMITTAL LETTER

August 30, 1999

J0135 U.S. PTO
09/30/99
09/30/99

TO THE ASSISTANT COMMISSIONER FOR PATENTS:

Transmitted herewith for filing under 37 C.F.R. § 1.53(b) by Express Mail is the complete patent application of: Richard Leslie Banyard and Ronald Matthew Dykes,

Title: LIQUID FOR PRODUCING MARKER VAPOUR, A METHOD OF PRODUCING MARKER VAPOUR AND A METHOD OF INSPECTION WITH MARKER VAPOUR

Executed On: 8/19/99

- X 1. An application consisting of 13 pages of specification and claims and 1 sheets of informal drawings is attached.
- X 2. A newly executed Declaration and Power of Attorney is attached.
- X 3. An Assignment of the invention to Graminia Developments Ltd. is attached. A Cover Sheet prepared in accordance with 37 C.F.R. § 3.31 is attached to the Assignment. Please record this Assignment in accordance with 37 C.F.R. § 3.11.
- X 4. A filing date in accordance with 37 C.F.R. § 1.10 is requested. The Express Mail Certificate appears below.
- X 5. Two Small Entity Statements are attached.

COMPUTATION OF FEE

	Number Filed		Number Extra		Rate		Basic Rate \$380.00
Total Claims	16 - 20	=	0	x	\$9	=	\$0.00
Independent Claims	3 - 3	=	0	x	\$39	=	\$0.00
Multiple Dependent Claims	0		---		\$130	=	\$0.00

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09/30/99 09:57:58

TOTAL

\$380.00

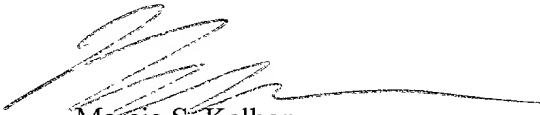
- X 6. Our check No. 108623 in the amount of \$380.00 to cover the total fee as computed above is enclosed.
- X 7. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16, 1.17 and 1.18 which may be required during the entire pendency of the application, or credit any overpayment, to Deposit Account No. 03-1740. This authorization also hereby includes a request for any extensions of time of the appropriate length required upon the filing of any reply during the entire prosecution of this application. A copy of this sheet is enclosed.

Please address all further correspondence to:

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Respectfully submitted,

CHRISTENSEN O'CONNOR
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Marcia S. Kelbon
Registration No. 34,358
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EXPRESS MAIL CERTIFICATE

"Express Mail" mailing label number EM 063 067 410 US

Date of Deposit 9/30/99

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

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Applicant or Patentee:
Attorney's Docket No.:
Serial or Patent No:
Filed or Issued:
For:

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9(f) and 1.27 (b)) - INDEPENDENT INVENTOR

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled **Liquid For Producing Marker Vapour, A Method of Producing Marker Vapour And A Method Of Inspection With Marker Vapour** described in

(xx) the specification filed herewith
() application serial no. , filed
() patent no. , issued

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

() no such person, concern, or organization
(xx) persons, concerns or organizations listed below*

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

FULL NAME: **Graminia Developments Ltd.**
ADDRESS: **7716 - 67 Street, Edmonton, Alberta, T6B 2K4, Canada**
() INDIVIDUAL (xx) SMALL BUSINESS CONCERN () NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

Small Entity Declaration

2

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such wilful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Richard Leslie Banyard
NAME OF INVENTOR


SIGNATURE OF INVENTOR

08/19/99
DATE

Ronald Matthew Dykes
NAME OF INVENTOR


SIGNATURE OF INVENTOR

08/19/99
DATE

00305768-003099

Applicant or Patentee:
Attorney's Docket No.:
Serial or Patent No.:
Filed or Issued:
For:

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) and 1.27(c)) - SMALL BUSINESS CONCERN

I hereby declare that I am

- ☐ the owner of the small business concern identified below:
☒ an official of the small business concern empowered to
act on behalf of the concern identified below:

FULL NAME OF CONCERN: **Graminia Developments Ltd.**
ADDRESS: **7716 - 67 Street, Edmonton, Alberta, T6B 2K4, Canada**

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled **Liquid For Producing Marker Vapour, A Method of Producing Marker Vapour And A Method Of Inspection With Marker Vapour** by inventors **Richard Leslie Banyard** and **Ronald Matthew Dykes** described in

- ☒ the specification filed herewith
☐ application serial no. _____, filed _____
☐ patent no. _____, issued _____

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held to any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e). *NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR

Small Entity Declaration

2

1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING: GERALD VANBERG.

TITLE OF PERSON OTHER THAN OWNER: *PRESIDENT*

ADDRESS OF PERSON SIGNING: 7716-67th EDMONTON, ALBERTA, T6B-2K9.
CANADA.

SIGNATURE

Herald Vanberg

DATE _____

Aug 19/99.

TITLE OF THE INVENTION:

Liquid For Producing Marker Vapour, A Method Of Producing
Marker Vapour And A Method Of Inspection With Marker Vapour

5 NAME(S) OF INVENTOR(S):

Richard Leslie Banyard
Ronald Matthew Dykes

FIELD OF THE INVENTION

10 The present invention relates to a liquid for producing
a marker vapour, a method of producing a marker vapour with the
liquid, and a method of inspection with marker vapour produced
from the liquid

15 BACKGROUND OF THE INVENTION

United States Patent 5,107,698 (Gilliam) discloses a smoke
generating apparatus used for leak detection. What is
described as a "fireproof hydraulic fluid" is splashed onto a
heating element. Upon contact with the heating element the
20 hydraulic fluid is vapourized with incomplete combustion
causing smoke as a byproduct. The smoke serves as a marker
vapour as it exits pin sized holes that are causing leaks.
This type of marker vapour is an aerosol, as it consists of a
plurality of particles dispersed in a gas.

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Toxicology reports on hydraulic fluid, and the smoke
produced thereby, indicate potential harm to humans. It is,
therefore, preferable that a switch be made to less toxic
mediums. Experiments have been made with visible vapours.
30 Visible vapours are gaseous forms of a normally liquid or solid
substances. However, it has been determined that as pressure
increases the visible vapours are no longer visible. The
pressure at which the visible vapours are no longer visible is
in a range of 30 to 50 psi, depending upon the lighting
35 conditions under which the visible vapour is being viewed and
the exit velocity of the visible vapour.

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5 SUMMARY OF THE INVENTION

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solvent based or water based carrier liquid. These existing fluorescent marker liquids proved not to be suitable for aerosol application, as the application of heat tended to separate their constituents. When a solvent based fluorescent marker liquid was exposed to vapourizing heat, the solvent tended to flash off, leaving the fluorescent substance behind. When a water based fluorescent marker liquid was exposed to vapourizing heat, the water tended to evaporate, leaving the fluorescent substance behind. Success was achieved by matching a fluorescent substance with a carrier fluid that had overlapping vapourization temperatures.

Although beneficial results were obtained through the use of the liquid for producing a marker vapour, as described above, it was discovered that the most effective vapourization temperature ranges for the carrier liquid frequently resulted in inefficient vapourization or even burning of the fluorescent substance, or vice versa. The fluorescent substance has a first critical point at which the liquid and vapour phases of the fluorescent substance are in equilibrium. The carrier liquid has a second critical point at which the liquid and vapour phases of the carrier liquid are at equilibrium. Even more beneficial results were obtained when the first critical point and the second critical point were substantially the same. This enabled a balancing of vapourization temperatures to be performed to efficiently vapourize both the fluorescent substance and the carrier liquid, without concern that accidental temperature fluctuations will result in combustion of one of the fluorescent substance or the carrier liquid. The process can be controlled to at all times maintain the temperature in the more efficient vapourization ranges and well below the combustion temperatures.

Although beneficial results may be obtained through the use of the liquid for producing marker vapour, as described above, it is preferred that the marker vapour be not only less harmful, but completely harmless. Even more beneficial results

may, therefore, be obtained when both the fluorescent substance and the carrier liquid are non-toxic. There are a variety of non-toxic food grade oils that are suitable for use. There are also a variety of non-toxic fluorescent substances presently
5 used in medical applications that are suitable.

After a series of unsuccessful experiments using water and various solvents as carrier liquids, beneficial results were first obtained using a non-toxic mineral oil and also using
10 glycerine. It will be appreciated that it should be possible to use a variety of carrier liquids, including water or solvent. The key to developing such liquid for producing marker vapour lies in finding a fluorescent substance that has a similar vapourization temperature range as water or the
15 particular solvent selected.

According to another aspect of the present invention there is provided a method of producing a marker vapour which includes the steps of providing a fluorescent marker liquid as
20 described above and vapourizing the fluorescent marker liquid at a temperature that is within both the first vapourization temperature range and the second vapourization temperature range. This forms a vapour that is visible at low pressure, and becomes visible at high pressure when exposed to radiation
25 of suitable wavelength.

Although beneficial results may be obtained through the use of the method, as described above, of the various ways of vapourization, the best results were obtained when the
30 fluorescent marker liquid was vapourized by atomizing the fluorescent marker liquid onto a heated substrate.

According to another aspect of the present invention there is provided a method of inspection with marker vapour which
35 includes the following described steps. A first step involves providing a fluorescent marker liquid consisting of a carrier liquid containing a fluorescent substance. A second step

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BRIEF DESCRIPTION OF THE DRAWINGS

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

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through a leaks. This pressure drop causes vapour 16 to experience a change in state from vapour to liquid, thereby depositing a fluorescent marker at the exit point. This enables anomalies or defects resulting in leakage to be clearly discernable upon inspection under black light 34. Pressure container can first be inspected at low pressure and then the pressure gradually increased while inspection under radiation from black light 34 continues. There are some inspection pressures specified in government regulations or manufacturer's specifications.

In developing this method of inspection two problems were encountered. Firstly, a liquid for producing a marker vapour containing fluorescent marker had to be developed. Secondly, a method of vapourizing the liquid to obtain the best results had to be developed. The liquid developed includes a fluorescent substance in solution in a carrier liquid. The fluorescent substance has a first vapourization temperature range at which the fluorescent substance vapourizes. The carrier liquid has a second vapourization temperature range at which the carrier liquid vapourizes. The second vapourization temperature range overlaps the first vapourization range.

It is preferred that vapour 16 be completely harmless to humans. There are a variety of non-toxic oils that are suitable for use as a carrier liquid. A source of such non-toxic carrier oils is Ostrem Chemicals Inc. There are also a variety of non-toxic fluorescent substances that are suitable. A source of such non-toxic fluorescent substances is Angstrom Technologies Inc. The fluorescent substances of Angstrom Technologies Inc. come in powder form and must be mixed gradually with the carrier liquid. Although a carrier oil is described, beneficial results are also obtainable with other carrier liquids, such as glycerine.

It must be appreciated that the fluorescent substance has a first critical point at which the liquid and vapour phases

of the fluorescent substance are in equilibrium. The carrier liquid has a second critical point at which the liquid and vapour phases of the carrier liquid are at equilibrium. The initial batches of carrier liquid and fluorescent substances had a narrow area of overlap between the first vapourization temperature range and the second vapourization temperature range. This proved the concept, but made it difficult to optimize the process. The fluorescent substance used had a vapourization temperature range of 350 degrees fahrenheit to 400 degrees fahrenheit. At temperatures above 400 degrees fahrenheit it started to burn. In contrast the carrier liquid had a vapourization temperature range of 350 degrees to over 500 degrees fahrenheit. It was discovered that an optimum vapourization temperature for the carrier liquid was 450 degrees fahrenheit, but at that temperature the fluorescent substance was being burned. It is, therefore, preferred that the fluorescent substance and the carrier liquid be selected so that the first critical point and the second critical point are substantially the same. This enables a balancing of vapourization temperatures to be performed, without concern that temperature fluctuations will result in inefficient vapourization or combustion of either the fluorescent substance or the carrier liquid. The process can be controlled to at all times maintain the temperature below the combustion temperature.

Once a suitable fluorescent marker liquid was developed, a method had to be developed for producing a marker vapour from the liquid. It was determined that the method used in the Gilliam reference was not effective. It was felt that the cause of the problem was that too much liquid was being delivered to the heating element at once. The best results were obtained when the fluorescent marker liquid was vapourized by atomizing the fluorescent marker liquid through atomizing nozzle 20 onto a heated substrate, such as concave dish 22.

It will be apparent to one skilled in the art that

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY
OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

- 5 1. A liquid for producing a marker vapour, comprising:
a fluorescent substance in solution in a carrier liquid,
the fluorescent substance having a first vapourization
temperature range at which the fluorescent substance vapourizes
and the carrier liquid having a second vapourization
10 temperature range at which the carrier liquid vapourizes and
the second vapourization temperature range overlapping the
first vapourization range.
- 15 2. The liquid for producing a marker vapour as defined in
Claim 1, wherein the fluorescent substance has a first critical
point at which the liquid and vapour phases of the fluorescent
substance are in equilibrium, and the carrier liquid has a
second critical point at which the liquid and vapour phases of
20 the carrier liquid are at equilibrium, the first critical point
and the second critical point being substantially the same.
- 25 3. The liquid for producing a marker vapour as defined in
Claim 1, wherein the fluorescent substance and the carrier
liquid are non-toxic.
4. The liquid for producing a marker vapour as defined in
Claim 1, wherein the carrier liquid is one of oil and
glycerine.

5. A method of producing a marker vapour, comprising the steps of:

providing a fluorescent marker liquid consisting of a
5 fluorescent substance in solution in a carrier liquid, the
fluorescent substance having a first vapourization temperature
range at which the fluorescent substance vapourizes and the
carrier liquid having a second vapourization temperature range
at which the carrier liquid vapourizes, the second
10 vapourization temperature range overlapping the first
vapourization range; and

vapourizing the fluorescent marker liquid at a temperature
that is within both the first vapourization temperature range
and the second vapourization temperature range, thereby forming
15 a vapour that is visible when exposed to radiation of suitable
wavelength.

6. The method as defined in Claim 5, wherein the fluorescent
substance has a first critical point at which the liquid and
20 vapour phases of the fluorescent substance are in equilibrium,
and the carrier liquid has a second critical point at which the
liquid and vapour phases of the carrier liquid are at
equilibrium, the first critical point and the second critical
point being substantially the same.

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7. The method as defined in Claim 5, the fluorescent marker
liquid being vapourized by application onto a heated substrate.

8. The method as defined in Claim 7, the application of the
30 fluorescent marker liquid onto the heated substrate being by
atomizing through an atomizing nozzle.

9. The method as defined in Claim 7, the heated substrate
being a concave surface.

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10. A method of inspection with marker vapour, comprising the steps of:

providing a fluorescent marker liquid consisting of a
5 carrier liquid containing a fluorescent substance;

vapourizing the marker liquid to produce a marker vapour;

directing the marker vapour into a pressure container
being inspected for pressure leaks;

10 inspecting an exterior of the pressure container under
radiation of suitable wavelength to cause the fluorescent
substance to fluoresce.

11. The method as defined in Claim 10, including the further
step of gradually increasing pressure in the container while
15 continuing to inspect the pressure container under radiation
of suitable wavelength.

12. The method as defined in Claim 10, the marker liquid
consisting of a fluorescent substance in solution in a carrier
20 liquid, the fluorescent substance having a first vapourization
temperature range at which the fluorescent substance vapourizes
and the carrier liquid having a second vapourization
temperature range at which the carrier liquid vapourizes and
the second vapourization temperature range overlapping the
25 first vapourization range.

13. The method as defined in Claim 12, wherein the fluorescent
substance has a first critical point at which the liquid and
vapour phases of the fluorescent substance are in equilibrium,
30 and the carrier liquid has a second critical point at which the
liquid and vapour phases of the carrier liquid are at
equilibrium, the first critical point and the second critical
point being substantially the same.

35 14. The method as defined in Claim 10, the fluorescent marker
liquid being vapourized by application onto a heated substrate.

5 16. The method as defined in Claim 14, the heated substrate
being a concave surface.

ABSTRACT OF THE DISCLOSURE

A liquid for producing a marker vapour includes a fluorescent substance in solution in a carrier liquid. The fluorescent substance has a first vaporization temperature range at which the fluorescent substance vaporizes. The carrier liquid has a second vaporization temperature range at which the carrier liquid vaporizes. The second vaporization temperature range overlaps the first vaporization range. The liquid is vaporized and directed into a body being inspected. Leaks then become visible when the body is inspected using radiation of a wavelength that causes the fluorescent substance to fluoresce.

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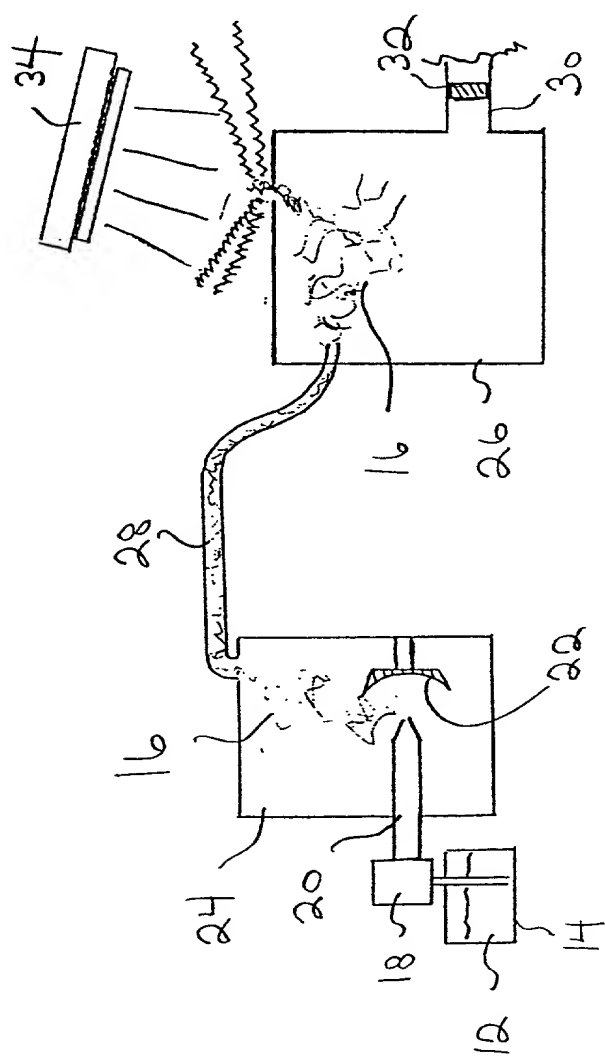


FIGURE 1

DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if one name is listed below) or an original, first and joint inventor (if more than one name is listed below) of the subject matter which is disclosed and/or claimed and for which a patent is sought on the invention entitled: **Liquid For Producing Marker Vapour, A Method of Producing Marker Vapour And A Method Of Inspection With Marker Vapour** the specification of which

xxx is attached hereto (as amended on _____)

_____ WAS FILED _____ as Application Serial No. _____
and was amended on _____.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Patent Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, S1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, s.119, of any foreign applications for patent or inventor's certificate or of any PCT international application designating at least one country other than the United States of America listed below and have also identified below any foreign application for patent or inventor's certificate or any PCT international application designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application of which priority is claimed:

Prior Foreign Applications

Priority Claimed

<u>Number</u>	<u>Country</u>	<u>Day/Month/Year filed</u>	<u>Yes</u>	<u>No</u>
	<u>Canada</u>	<u>29 July 1999</u>	<u>xx</u>	

I hereby appoint the following agent to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

I hereby appoint the following attorneys and/or agents to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith: Bruce E. O'Connor, Reg. No. 24,849; Lee E. Johnson, Reg. No. 22,946; Gary S. Kindness, Reg. No. 22,178; James W. Anable, Reg. No. 26,827; James

Declaration for application

2

R. Uhler, Reg. No. 25,096; Jerald E. Nagae, Reg. No. 29,418; Thomas F. Broderick, Reg. No. 31,332; Dennis K. Shelton, Reg. No. 26,997; Jeffrey M. Sakoi, Reg. No. 32,059; Ward Brown, Reg. No. 28,400; Robert J. Carlson, Reg. No. 35,472; Marcia S. Kelbon, Reg. No. 34,358; Paul L. Gardner, Reg. No. 22,372; and the firm of Christensen, O'Connor, Johnson & Kindness^{PLLC} and Anthony R. Lambert, regn. no. 32,813.

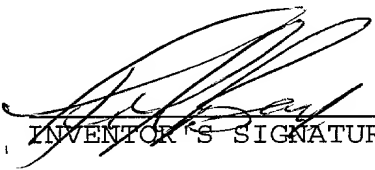
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Address all correspondence to:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such wilful false statements may jeopardize the validity of the application or any patent issued thereon.

Richard Leslie Banyard
FULL NAME OF SOLE/FIRST INVENTOR


INVENTOR'S SIGNATURE

08/19/99
DATE

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Ronald Matthew Dykes
FULL NAME OF JOINT/SECOND INVENTOR


INVENTOR'S SIGNATURE

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